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Consider the planar supersonic flow of a mixture of several chemically interactive gases which is assumed to undergo nonequilibrium chemical transformation. Assume the gas to be ideal and that its nonequilibrium transformation is accompanied by a sudden change in the adiabatic index (ratio of specific heats c_p/c_v) from k_1 to k_2 , with the liberation, or absorption, of heat.

We obtain, by ordinary laws of conservation of energy (p and $w^2/2g$), the general energy equation for the above-mentioned flow process, relating velocity (w), volume (v), and pressure (p) before and after the sudden change; allowance is made for the heat of reaction and the total heat effect (q).

The above flow equations are simplified by the introduction of reduced (dimensionless) quantities for the velocity (w/a^* , where a^* is the so-called critical velocity, or speed of sound.) Then the reduced velocity is found as a double-valued function of another reduced parameter; namely $e = Ba_1/a_2$, where a_1 involves k_1 , a_2 involves k_2 and B is the ratio of thermal energies i_{01} and i_{02} . The double-valued function results from solving a quadratic expression.

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1. $k_1 > k_2$ and $i_{01} = i_{02}$. Sudden changes in rarefaction are thermodynamically forbidden; only at 0°K are sudden changes in Type II condensation possible (Note: Type II is a new type referring to a direct sudden change in condensation which occurs in supersonic gas flow during nonequilibrium chemical transformation).

2. $k_1 < k_2$ and $i_{01} = i_{02}$. Sudden changes in rarefaction are thermodynamically admissible, but only at 0°K. Sudden changes in condensation, Type I or II, can form.

3. $k_1 = k_2$ and $i_{01} > i_{02}$. Sudden changes in rarefaction are thermodynamically forbidden. Sudden changes in Type II condensation are impossible; only the usual changes occur.

4. $k_1 = k_2$ and $i_{01} < i_{02}$. Sudden changes in rarefaction are thermodynamically admissible, but usually do not arise. Sudden changes in Types I and II condensation occur.

These results are more general than those of Belen'kiy, who assumed $a_1 = a_2$.

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